CLAIMS

1. A radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which extracts a desired signal by adaptive array processing, the device comprising:

adaptive array processing means (1) for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract said desired signal; and

array parameter optimal value estimation means (1a, 1b) for estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing means.

2. The radio receiving device according to claim 1, wherein

said array parameter optimal value estimation means includes:

determination means for determining a propagation environment of said reception signals;

storage means for previously storing a table consisting of optimal values of the array parameter corresponding to different conditions of said propagation environment; and

table reference means for referring to said table, thereby estimating an optimal value of said array parameter appropriate to the propagation environment of the reception signals determined by said determination means.

3. The radio receiving device according to claim 1, wherein

said array parameter optimal value estimation means includes:

operation control means for causing said adaptive array processing means to operate multiple times in a single time slot, in correspondence with a plurality of values

of said array parameter;

indicator calculation means for calculating an indicator representing the weight estimation performance of said adaptive array processing means corresponding to a current value of said array parameter, each time said adaptive array processing means is operated; and

optimal value estimation means for estimating a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means in said time slot, based on said calculated indicators.

4. The radio receiving device according to claim 3, wherein

said operation control means employs, as one of the plurality of values of said array parameter in a succeeding time slot, the value of said array parameter estimated by said optimal value estimation means in a preceding time slot; and

said optimal value estimation means estimates, based on the indicators calculated by said indicator calculation means over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means over said plurality of time slots.

5. The radio receiving device according to claim 1, wherein

said array parameter optimal value estimation means includes:

operation control means for causing the adaptive array processing means to operate in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time slots;

indicator calculation means for calculating an indicator representing the weight estimation performance of said adaptive array processing means corresponding to a current fixed value of said array parameter, each time said adaptive array processing means is operated;

averaging means for averaging said calculated indicator over said plurality of

time slots;

repeat control means for causing said operation control means, said indicator calculation means and said averaging means to repeatedly execute their operations over said plurality of time slots; and

optimal value estimation means for determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means, based on the indicators each averaged by said averaging means over said corresponding plurality of time slots.

6. A radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the device comprising:

adaptive array processing means (1 to 4), provided in correspondence with said respective users' terminals, for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

array parameter optimal value estimation means (1a to 4a, 1d to 4d) for estimating optimal values of the predetermined type of array parameter which optimize the weight estimation performance of said respective adaptive array processing means, wherein

said array parameter optimal value estimation means includes:

determination means for determining a propagation environment of said reception signal;

storage means for previously storing a table consisting of optimal values of the array parameter corresponding to different conditions of said propagation environment; and

table reference means for referring to said table, thereby estimating an optimal

value of said array parameter appropriate to the propagation environment of the reception signals determined by said determination means.

7. The radio receiving device according to claim 6, wherein

said propagation environment is at least one of the degree of multiplexing of spatial multiple connection and the amount of fading.

8. A radio receiving device (2000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the device comprising:

adaptive array processing means (11 to 14), provided in correspondence with said respective users' terminals, for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

array parameter optimal value estimation means (11a to 14a, 11d to 14d, 15, 16) for estimating optimal values of the predetermined type of array parameter which optimize the weight estimation performance of said respective adaptive array processing means, wherein

said array parameter optimal value estimation means includes:

operation control means for causing said adaptive array processing means to operate multiple times in a single time slot, in correspondence with a plurality of values of said array parameter;

indicator calculation means for calculating an indicator representing the weight estimation performance of said adaptive array processing means corresponding to a current value of said array parameter, each time said adaptive array processing means is operated; and

optimal value estimation means for estimating a value of said array parameter

which optimizes the weight estimation performance of said adaptive array processing means in said time slot, based on said calculated indicators.

9. The radio receiving device according to claim 8, wherein

said operation control means employs, as one of the plurality of values of said array parameter in a succeeding time slot, the value of said array parameter estimated by said optimal value estimation means in a preceding time slot; and

said optimal value estimation means estimates, based on the indicators calculated by said indicator calculation means over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means over said plurality of time slots.

10. A radio receiving device (3000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the device comprising:

adaptive array processing means (21 to 24), provided in correspondence with said respective users' terminals, for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

array parameter optimal value estimation means (21a to 24a, 21d to 24d, 21e to 24e) for estimating optimal values of said predetermined type of array parameter which optimize the weight estimation performance of said respective adaptive array processing means, wherein

said array parameter optimal value estimation means includes:

operation control means for causing the adaptive array processing means to operate in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time slots;

indicator calculation means for calculating an indicator representing the weight estimation performance of said adaptive array processing means corresponding to a current fixed value of said array parameter, each time said adaptive array processing means is operated;

averaging means for averaging said calculated indicators over said plurality of time slots;

repeat control means for causing said operation control means, said indicator calculation means and said averaging means to repeatedly execute their operations over said plurality of time slots; and

optimal value estimation means for determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means, based on the indicators each averaged by said averaging means over said plurality of time slots.

11. The radio receiving device according to any one of claims 3, 4, 5, 8, 9 and 10, wherein

the indicator representing the weight estimation performance of said adaptive array processing means is a weight estimation error.

12. An array parameter optimal value estimation method for use in a radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which extracts a desired signal by adaptive array processing, the method comprising the steps of:

executing adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract said desired signal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing.

13. The array parameter optimal value estimation method according to claim 12, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

determining a propagation environment of said reception signals;

preparing in advance a table consisting of optimal values of said array parameter corresponding to different conditions of said propagation environment; and

referring to said table, thereby estimating an optimal value of said array parameter appropriate to said determined propagation environment of the reception signals.

14. The array parameter optimal value estimation method according to claim 12, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing said adaptive array processing step to be executed multiple times in a single time slot, in correspondence with a plurality of values of said array parameter;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current value of said array parameter, each time said adaptive array processing step is executed; and

estimating a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing in said time slot, based on said calculated indicators.

15. The array parameter optimal value estimation method according to claim 14, wherein

the step of causing said adaptive array processing step to be executed multiple times includes the step of employing the value of said array parameter estimated in a

preceding time slot, as one of the plurality of values of said array parameter in a succeeding time slot, and

the step of estimating a value of said array parameter includes the step of estimating, based on the indicators calculated over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing over said plurality of time slots.

16. The array parameter optimal value estimation method according to claim 12, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing the adaptive array processing step to be executed in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time slots;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current fixed value of said array parameter, each time said adaptive array processing step is executed;

averaging said calculated indicators over said plurality of time slots;

causing the operations of the steps of causing said adaptive array processing step to be executed, calculating said indicator, and averaging over said plurality of time slots to be executed repeatedly; and

determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing, based on said indicators each averaged over said plurality of time slots.

17. An array parameter optimal value estimation method for use in a radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing,

the method comprising the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding user's terminal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating the optimal value of said array parameter includes the steps of:

determining a propagation environment of said reception signals;

preparing in advance a table consisting of optimal values of said array parameter corresponding to different conditions of said propagation environment; and

referring to said table, thereby estimating an optimal value of said array parameter appropriate to the determined propagation environment of said determined reception signals.

18. The array parameter optimal value estimation method according to claim 17, wherein

said propagation environment is at least one of the degree of multiplexing of spatial multiplex connection and the amount of fading.

19. An array parameter optimal value estimation method for use in a radio receiving device (2000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the method comprising the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array

parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

estimating an optimal value of the predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing said adaptive array processing step to be executed multiple times in a single time slot, in correspondence with a plurality of values of said array parameter;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current value of said array parameter, each time the adaptive array processing step is executed; and

estimating a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing in said time slot, based on said calculated indicators.

20. The array parameter optimal value estimation method according to claim 19, wherein

the step of causing said adaptive array processing step to be executed multiple times includes the step of employing the value of said array parameter estimated in a preceding time slot, as one of the plurality of values of said array parameter in a succeeding time slot, and

the step of estimating a value of said array parameter includes the step of estimating, based on said indicators calculated over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing over said plurality of time slots.

21. An array parameter optimal value estimation method for use in a radio

receiving device (2000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the method comprising the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing the adaptive array processing step to be executed in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time slots;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current fixed value of said array parameter, each time said adaptive array processing step is executed;

averaging said calculated indicators over said plurality of time slots;

causing the operations of the steps of causing said adaptive array processing step to be executed, calculating said indicator, and averaging over said plurality of time slots to be executed repeatedly; and

determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing, based on the indicators each averaged over said plurality of time slots.

22. The array parameter optimal value estimation method according to any one of claims 14, 15, 16, 19, 20 and 21, wherein

the indicator representing the weight estimation performance of said adaptive array processing is a weight estimation error.

23. An array parameter optimal value estimation program for use in a radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which extracts a desired signal by adaptive array processing, the program causing a computer to execute the steps of:

executing the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract the desired signal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing.

24. The array parameter optimal value estimation program according to claim 23, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

determining a propagation environment of said reception signals;

preparing in advance a table consisting of optimal values of said array parameter corresponding to different conditions of said propagation environment; and

referring to said table, thereby estimating an optimal value of said array parameter appropriate to said determined propagation environment of the reception signals.

25. The array parameter optimal value estimation program according to claim 23, wherein

the step of estimating an optimal value of said array parameter includes the steps

of:

causing said adaptive array processing step to be executed multiple times in a single time slot, in correspondence with a plurality of values of said array parameter;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current value of said array parameter, each time said adaptive array processing step is executed; and

estimating a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing in said time slot, based on said calculated indicators.

26. The array parameter optimal value estimation program according to claim 25, wherein

the step of causing said adaptive array processing step to be executed multiple times includes the step of employing the value of said array parameter estimated in a preceding time slot, as one of the plurality of values of said array parameter in a succeeding time slot, and

the step of estimating a value of said array parameter includes the step of estimating, based on the indicators calculated over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing over said plurality of time slots.

27. The array parameter optimal value estimation program according to claim 23, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing the adaptive array processing step to be executed in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time slots;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current fixed value of said array parameter, each time said adaptive array processing step is executed;

averaging said calculated indicators over said plurality of time slots;

causing the operations of the steps of causing said adaptive array processing step to be executed, calculating said indicator, and averaging over said plurality of time slots to be executed repeatedly; and

determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing, based on the indicators each averaged over said plurality of time slots.

28. An array parameter optimal value estimation program for use in a radio receiving device (1000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the program causing a computer to execute the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

determining a propagation environment of said reception signals;

preparing in advance a table consisting of optimal values of said array parameter corresponding to different conditions of said propagation environment; and

referring to said table, thereby estimating an optimal value of said array

parameter appropriate to the determined propagation environment of said reception signals.

29. The array parameter optimal value estimation program according to claim 28, wherein

said propagation environment is at least one of the degree of multiplexing of spatial multiple connection and the amount of fading.

30. An array parameter optimal value estimation program for use in a radio receiving device (2000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminals by adaptive array processing, the program causing a computer to execute the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

estimating an optimal value of the predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing said adaptive array processing step to be executed multiple times in a single time slot, in correspondence with a plurality of values of said array parameter;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current value of said array parameter, each time said adaptive array processing step is executed; and

estimating a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing in said time slot, based on said calculated

indicators.

31. The array parameter optimal value estimation program according to claim 30, wherein

the step of causing said adaptive array processing step to be executed multiple times includes the step of employing the value of said array parameter estimated in a preceding time slot, as one of the plurality of values of said array parameter in a succeeding time slot, and

the step of estimating a value of said array parameter includes the step of estimating, based on said indicators calculated over a plurality of time slots, a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing over said plurality of time slots.

32. An array parameter optimal value estimation program for use in a radio receiving device (3000) which has a plurality of antennas (A1 to A4) and which enables spatial multiple connection of a plurality of users' terminal by adaptive array processing, the program causing a computer to execute the steps of:

executing, for said respective users' terminals, the adaptive array processing for estimating weights for said plurality of antennas using a predetermined type of array parameter, assigning said estimated weights to reception signals received by said plurality of antennas, and combining the weighted reception signals to extract a signal from said corresponding users' terminal; and

estimating an optimal value of said predetermined type of array parameter which optimizes the weight estimation performance of said adaptive array processing, wherein

the step of estimating an optimal value of said array parameter includes the steps of:

causing the adaptive array processing step to be executed in each of a plurality of time slots using a value of said array parameter which is fixed over said plurality of time

slots;

calculating an indicator representing the weight estimation performance of said adaptive array processing corresponding to a current fixed value of said array parameter, each time said adaptive array processing step is executed;

averaging said calculated indicators over said plurality of time slots;

causing the operations of the steps of causing said adaptive array processing step to be executed, calculating said indicator, and averaging over said plurality of time slots to be executed repeatedly; and

determining a value of said array parameter which optimizes the weight estimation performance of said adaptive array processing means, based on the indicators each averaged over said plurality of time slots.

33. The array parameter optimal value estimation program according to any one of claims 25, 26, 27, 30, 31 and 32, wherein

the indicator representing the weight estimation performance of said adaptive array processing means is a weight estimation error.